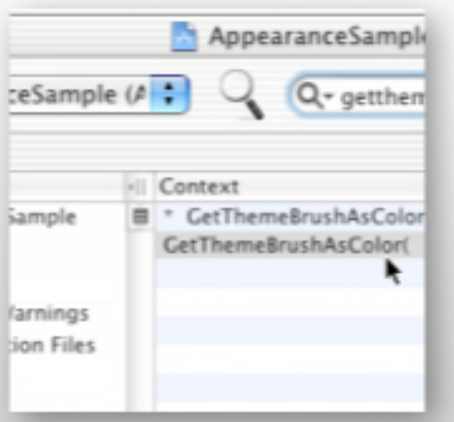
Interfacing Professional Video Hardware With Final Cut Pro 4

Session 005



Interfacing Professional Video Hardware With Final Cut Pro 4

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Introduction

- Final Cut Pro 4
- Apple is committed to delivering top notch professional video applications
- We want your help expanding the capabilities of Final Cut Pro with your professional video hardware

What You'll Learn

- Two kinds of video hardware
- RT Extreme
- A/V playback architecture
- RT enabler
- Developer opportunities
- Uncompressed codecs from Apple
- Pro IO

Final Cut Pro Format Flexibility

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- Handles low resolution offline to HD online
- Software versions primarily support OfflineRT, DV, and FireWire DV video out
- Hardware can add SD and HD I/O and acceleration

FCP Real-Time Effects History

- 2.0 Spring 2001
  - Real-time effects with QuickTime
  - Hardware acceleration

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- 3.0 Winter 2001
  - G4 Real-time effects (software)
- 4.0 Spring 2003
  - RT Extreme (software)
  - Software effects to video out
  - Expanded hardware effect capability

Two Kinds of Video Hardware

- High performance effect acceleration
  - Enables capabilities beyond the host CPU
- Simple video I/O
  - No effects or software effects
  - Possibly using hardware codecs

RT Extreme

- New FX
  - FX Scripts
  - Variable speed
- OpenGL FX
- Uncompressed formats (8 and 10 bit)
- YUV 4:2:2 and 4:4:4:4 processing
- 3:2 pulldown

Demo

RT Extreme

- Performance keeps getting better
  - Panther
  - G5

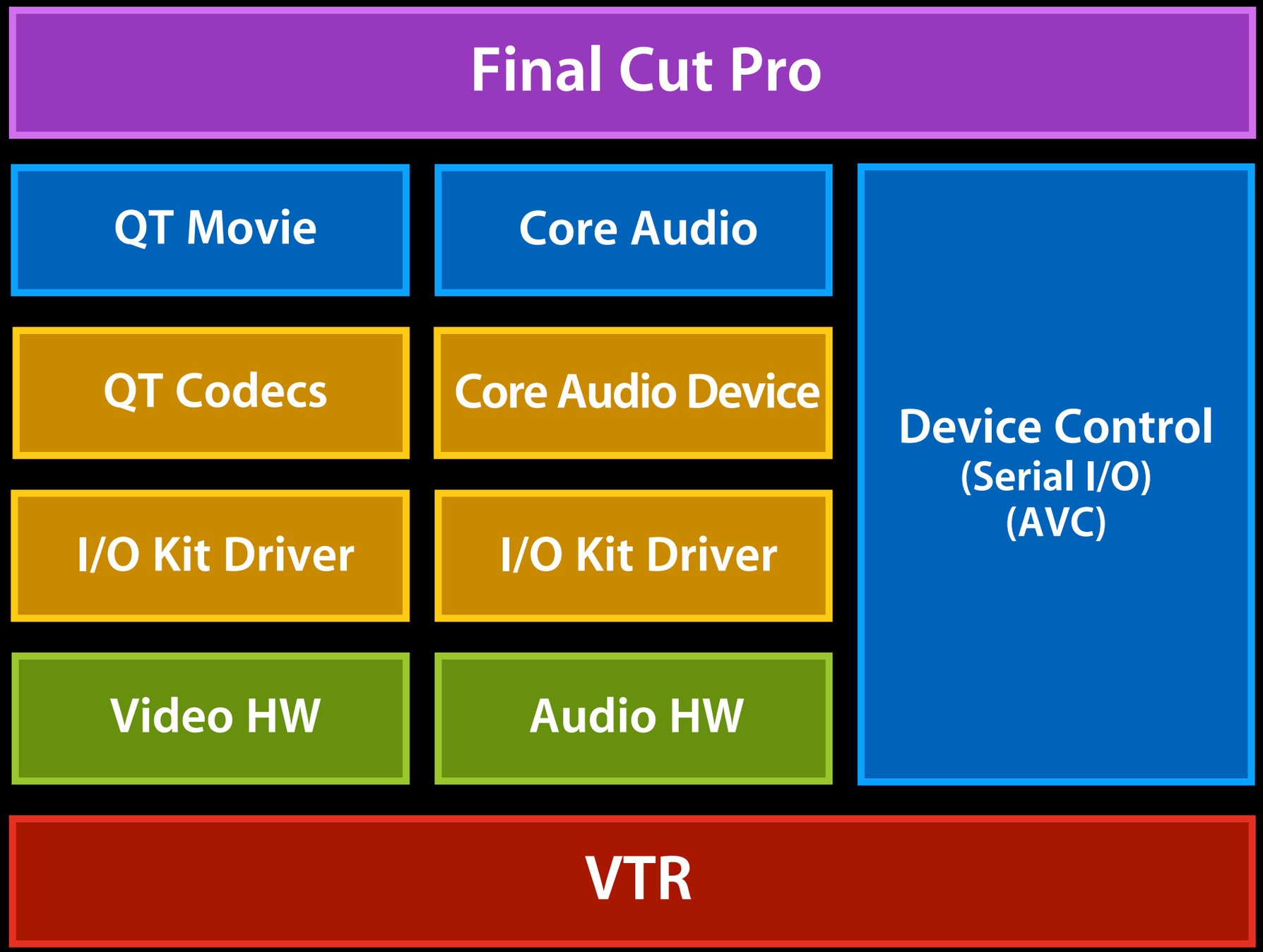
Hardware Real-Time Effects

- New in FCP 4
  - Variable speed
  - Mixed formats in one timeline

Floating Point Rendering

- High quality 128 bits per pixel YUV plus alpha
  - r4fl format
- VTRs top out at 10 bits
  - v210 format
- Optimized sample code for converting 8 bit and 10 bit YUV to r4fl
- Open QuickTime codec model allows developers to create higher resolution file formats (e.g., 16 bits per channel)

Playback Architecture Diagram



Standard Effects

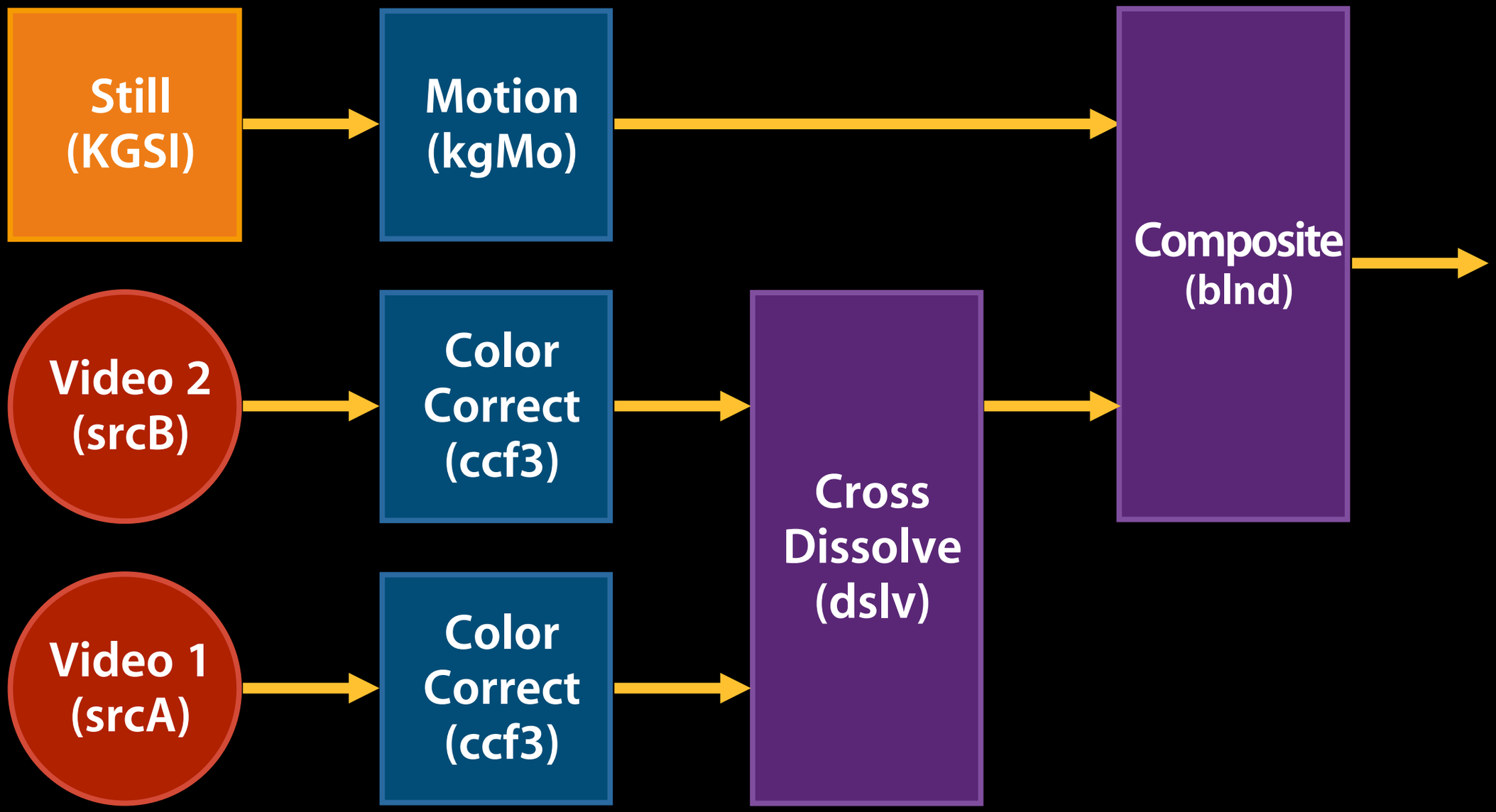
- From QuickTime
  - Composite (blnd)
  - Alpha gain (gain)
  - Cross dissolve (dslv)

Standard Effects

- From QuickTime
  - Composite (blnd)
  - Alpha gain (gain)
  - Cross dissolve (dslv)
- From FCP
  - Color correct 3-way (ccf3)
  - Speed (spEd)
  - RT Data (KGRT)
  - RT Stills (KGSI)
  - Motion (kgMo)

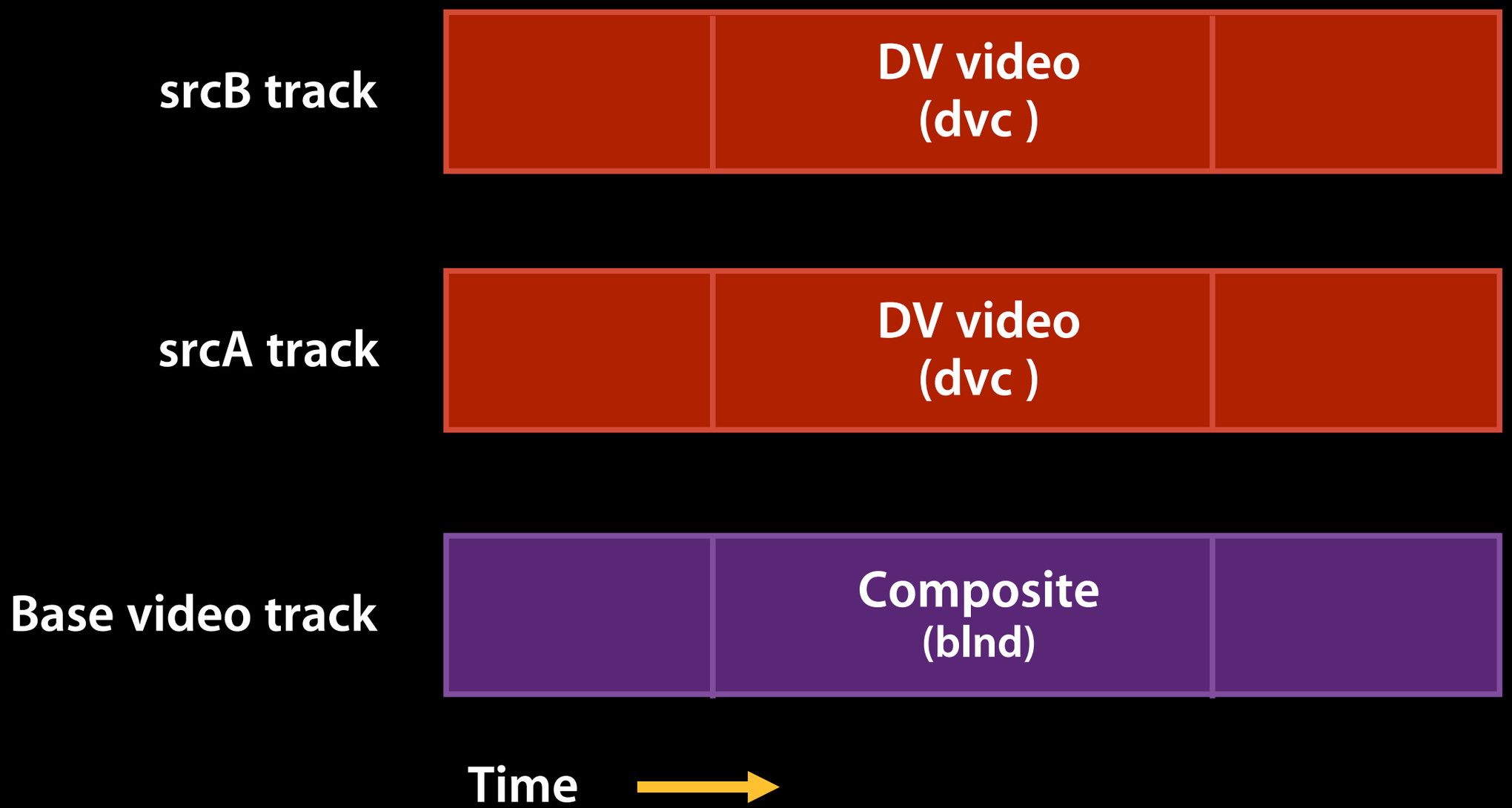
Effect Nesting Diagram

Moving, still, over, cross, dissolve of color corrected DV video sources

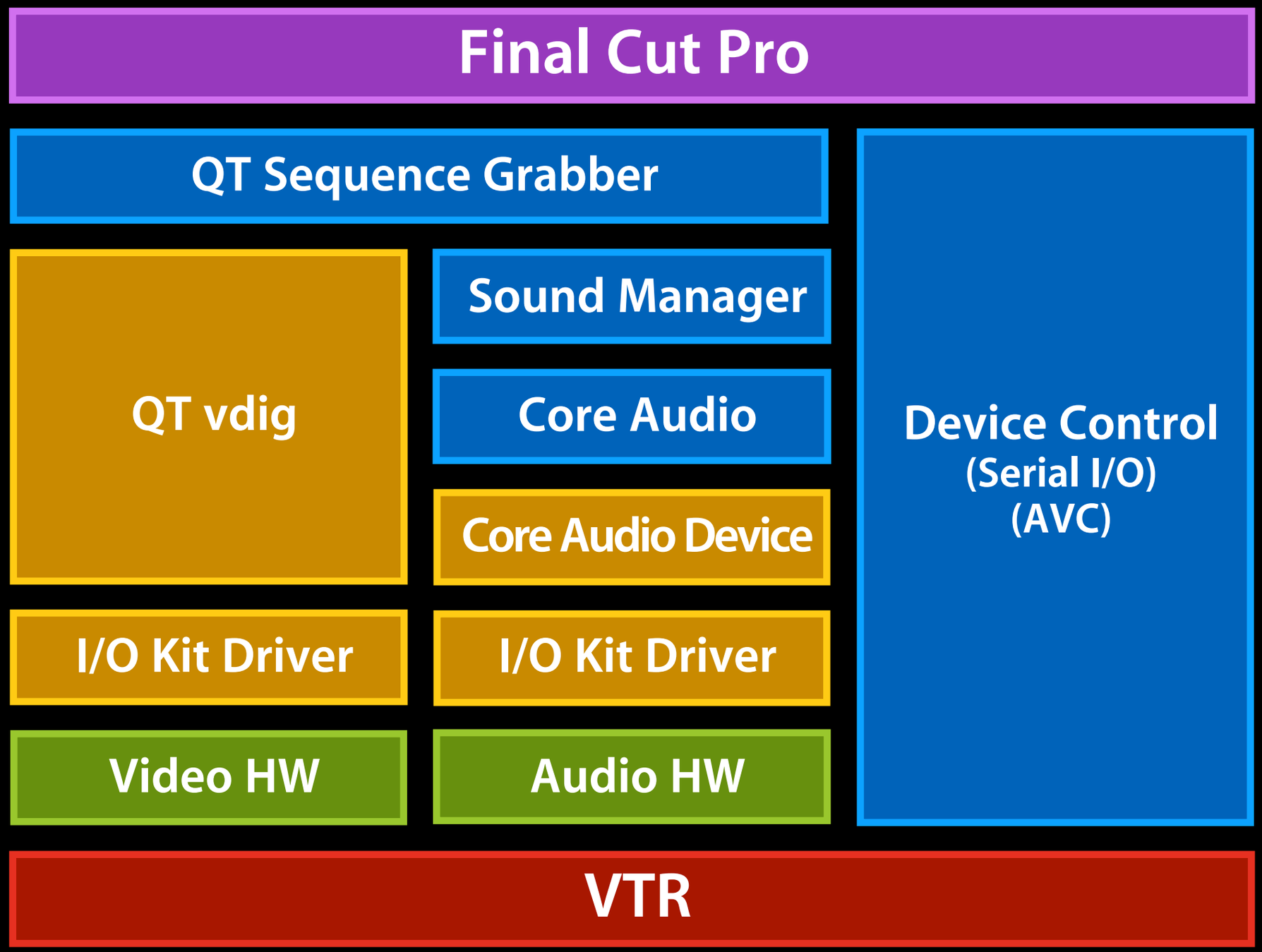


Movie Tracks Diagram

Moving, still, over, cross, dissolve of color corrected DV video sources



Capture Architecture Diagram



Additional Driver Issues for FCP

- A/V sync on playback
- A/V sync on capture
- VTR device control via USB

RT Enablers

- Startup scripts that help configure FCP for real-time effects
- Effect mapping
  - User selects standard FX Script effects
  - Systems with RT capability map selected FX Scripts to QuickTime RT effects
- Keeps projects portable

RT Enablers

- Effect costing (how much RT is possible)
  - RT Extreme with video out provides simple costing for developers (scale factor from built-in costs)
  - Hardware accelerated RT needs to develop costing from two models:
    - Time budget
    - Resource budget

RT Enablers

- Changes for FCP 4
  - Manufacturer name for Effect Handling tab
  - New shorthand commands
    - Reduce enabler size and maintenance
  - Debugging flag to log info to console
    - Helps answer “why isn’t this RT”
  - Let us know about other things we can do here

RT Enablers

- Example, enabling 8 bit uncompressed RT Extreme and video out from RT Extreme

```
// Enable 2vuy software effects.
dictput(TRUE, “switches”, “realtimeVideoFX”,
      “enable2vuyEffects”, “value”);

// Enable video out to Alpine.
dictput(1, “switches”, “realtimeVideoFX”,
      “enableSoftwareRTVideoOut”, “Alpn2vuy”, “scale”);
```

Developer Opportunities

- Hardware acceleration
  - SD
  - HD
  - 3:2 pulldown
  - Other codecs

Developer Opportunities

- Hardware acceleration
  - SD
  - HD
  - 3:2 pulldown
  - Other codecs
- RT Extreme
  - IO device (PCI or FireWire)
  - NTSC or PAL monitoring

Developer Opportunities

- Hardware acceleration
  - SD
  - HD
  - 3:2 pulldown
  - Other codecs
- RT Extreme
  - IO device (PCI or FireWire)
  - NTSC or PAL monitoring
- FX Scripts
- After Effects Plugins

Developer Opportunities

- HD video
  - Same basic architecture as SD
  - Much greater bandwidth
  - New Apple hardware helps
    - G5 with PCI-X and high bandwidth bus
    - Xserve RAID

Uncompressed 422 Codecs

Giovanni Agnoli
Final Cut Pro Engineering
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FCP Uncompressed 422 Codecs

- Standard 8 and 10 bit uncompressed YCbCr 4:2:2 software codecs
- Currently shipping as part of FCP bundle
- Available to developers for inclusion in their products
- Facilitates exchange of uncompressed data
- Removes need for vendor specific codecs
- Tuned to take advantage of latest hardware
- Native format support in FCP 4.0

Format Description

- 8 bit YCbCr 4:2:2 (2vuy)
- 10 bit YCbCr 4:2:2 (v210)
- QT Ice Floe Dispatch 19 (Chris Pirazzi, Dec 99)
  - http://developer/apple.com/quicktime/icefloe/dispatch019.html

Codec Capabilities

- Compress and decompress from common formats
  - 2vuy codec supports r408, 32, v408, 2vuy
  - v210 codec supports r408, 32, v408, 2vuy, r4fl, b64a
- Supports QT gamma level APIs
- Optimized for latest hardware (lots of Altivec loops)

Benefits

- Highest quality
- Common file format
- Better user workflow
- Native format support in FCP 4.0
- Free optimized code
- Less work for developers

ProIO

ProIO Philosophy

- Ever increasing processing power
- Decreasing cost of storage
- RT Extreme—software effects
- ProIO—professional input/output
- FireWire—plug and play

ProIO Architecture

- Data Transfer Protocol Specification
  - Uncompressed a/v over 1394a (~230mbs)
    - NTSC/PAL, 8/10 bit YCbCr 4:2:2 video
    - 8 channels, 16/24 bit 44.1-96kHz audio
  - Packetization, framing of data
  - Flow control techniques

- FireWire Unit Specifications

ProIO Architecture

- FireWire Unit Specifications
  - A/V unit
  - Serial unit
  - Firmware upgrade unit

Developer Opportunities

- ProIO devices
  - Analog IO
    - Component, Composite, S-Video, XLR, RCA…
  - Digital IO
    - SDI, AES, ADAT, SPDIF
  - Both
  - ?

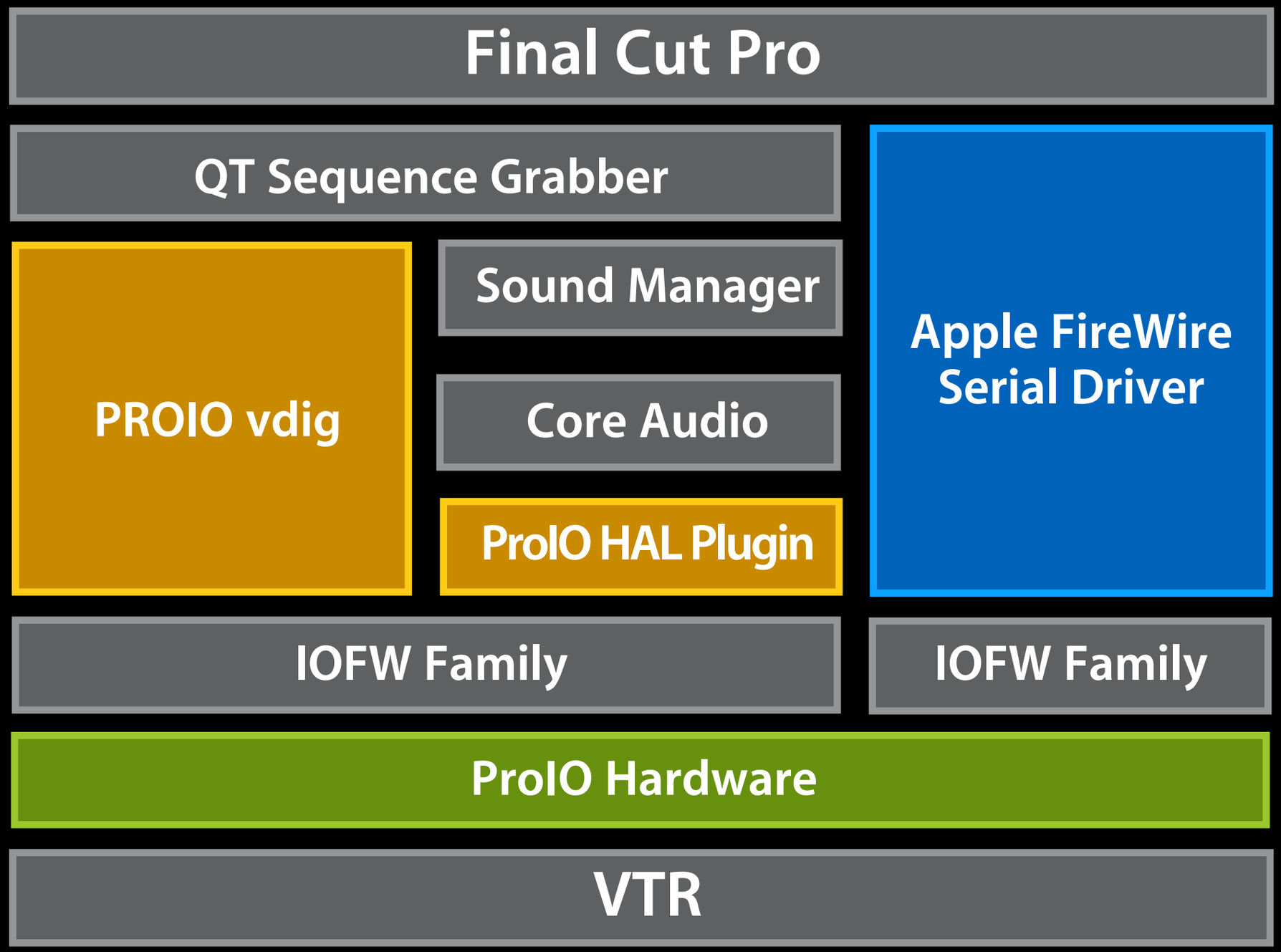
AJA Io

AJA
AJA Video Systems, Inc.
www.aja.com
Io - 101351
Ch. 1/2 In
Ch. 3/4 In
AES Audio
Ch. 1/2 Out
Ch. 3/4 Out
Ch. 1 In
Ch. 2 In
Ch. 3 In
Ch. 4 In
Analog Audio
Ch. 1 Out
Ch. 2 Out
Ch. 3 Out
Ch. 4 Out
Ch 1-8 In
adat
Ch 1-8 Out
Channels 1-8 Out
Analog Audio Monitor
RS-422
Out
Audio Word Clock
Out
PrR In
YG In
PbB In
Component
PrR Out
YG Out
PbB Out
In
Composite
Out
In
S-Video
Out
In
Out 1
SDI
Loop Out
Out 2
Loop
Ref
Loop
100 - 240VAC 20W
50/60Hz 0.5A

ProIO Driver 1.0 Release

- Provides standard QT driver set for ProIO Devices
  - vdig, CA HAL Plugin input device
  - vout, vout xfer codec, vout clock, CA HAL Plugin output device
- Additional support for FCP specific APIs
  - A/V sync, deck control
- Apple FireWire Serial Driver—William Gulland
- Optimized for latest hardware (altivec loops)
- Released 6/25

Capture Architecture Diagram



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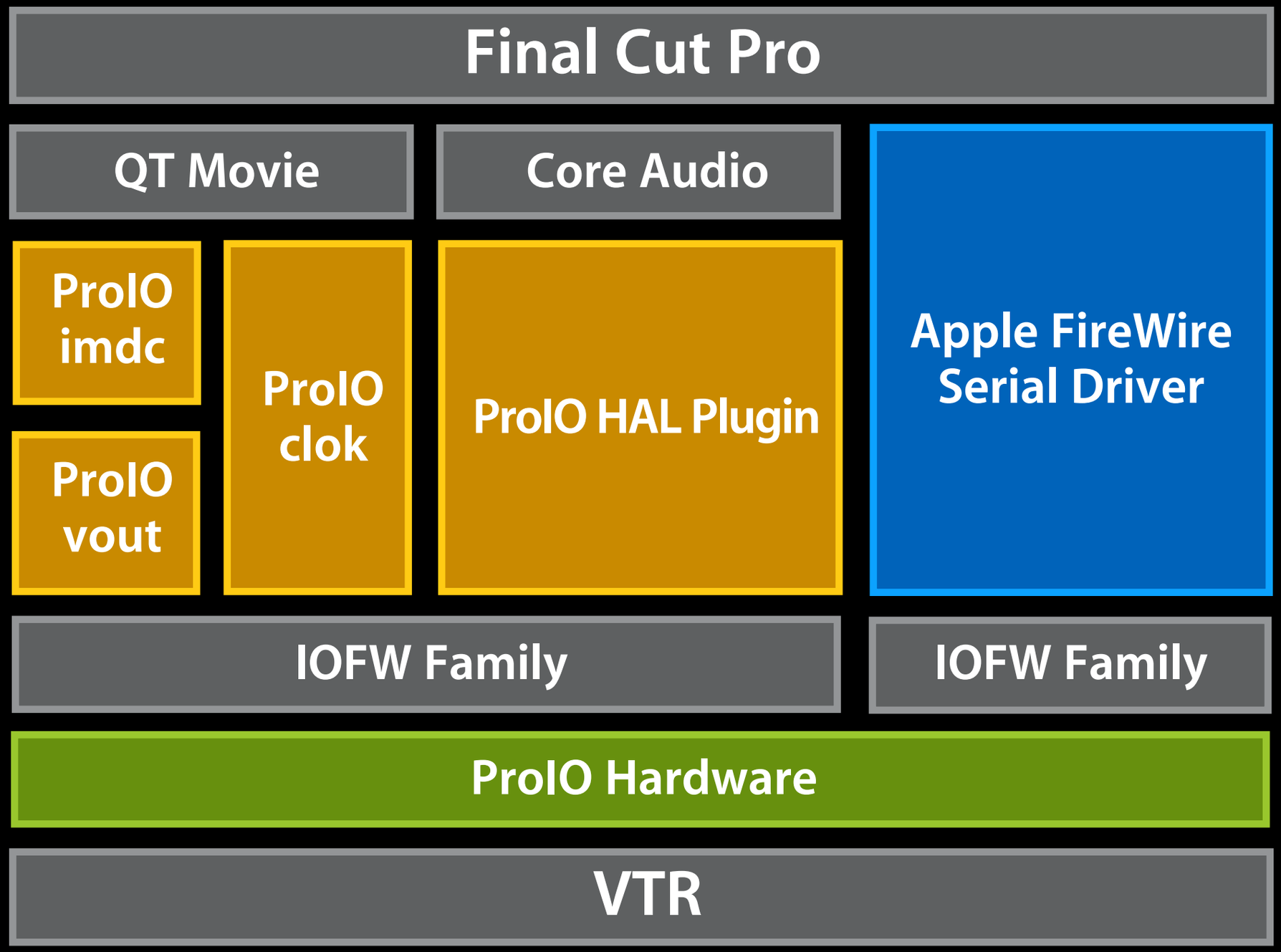

More Information

- Uncompressed 422 codec Licensing
- ProIO Licensing
- ProIO Kitchen (Q3)

Who to Contact

Jeff Lowe
jefflowe@apple.com

Wrap Up

Roadmap

700 Using Final Cut Pro for Professional Content Creation	Haight/Ashbury Mon., 5:00pm
002 Developer Opportunities with Apple's Professional Applications	Nob Hill Tue., 9:00am
003 Creating Content for Soundtrack and LiveType	Pacific Heights Tue., 2:00pm
004 Data Interchange for Professional Media Applications	Pacific Heights Wed., 10:30am
006 Extending Professional Applications with Plug-ins	Marina Fri., 3:30pm
FF020 Final Cut Pro Feedback Forum	Russian Hill Fri., 5:00pm

Who to Contact

Jeff Lowe
Industry Evangelist for Professional Film and Video
jefflowe@apple.com

http://developer.apple.com/wwdc2003/urls.html

For More Information

Reference Library

Documentation

Uncompressed Video Formats

http://developer.apple.com/quicktime/icefloe/dispatch019.html

QuickTime Effects

http://developer.apple.com/documentation/QuickTime/RM/EffectsTransitions/Effects/index.html

Audio

http://developer.apple.com/audio/

I/O Kit Device Drivers

http://developer.apple.com/documentation/DeviceDrivers/Conceptual/WritingDeviceDriver/index.html

Q&A

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http://developer.apple.com/wwdc2003/urls.html

WWDC 2003

Worldwide Developers Conference